



ELECTRIC DISTRIBUTION TRANSFORMATION PROGRAM

Mission

To transform today's electric distribution infrastructure for increased affordability, security, resilience, and reliability through integration of advanced communications, information analysis and management, sensors and controls, power electronics, and distributed energy resources (DER).

Overview

The Electric Distribution Transformation Program supports the development of technologies and standards that enable the integration of DER (distributed generation, storage, and demand/load management) and advanced power electronics into electric systems. The Program develops standards for interconnection and system architecture; conducts research on advanced technologies in sensing, communications, control, and power electronics; demonstrates integrated electric and market operations; and provides a technical foundation to support stakeholders in developing regulations that embody real valuation of electric services and DER.

Program Areas

The Program works in six main areas to better integrate DER with the electric distribution system. These areas are as follows.

System Architecture & Standards

The Program develops, through building consensus of key stakeholders, an architectural reference guide for integration of communications, information, control, and market systems. This guide and associated standards will serve as the backbone for the interoperation of electric delivery services with market operations to provide economic value streams for energy consumers, suppliers, and service providers.

Distribution Interconnection Standards & Technologies

The Program supports the development of national standards (i.e., Institute of Electrical and Electronics Engineers [IEEE] P1547 Series and Underwriters Laboratory [UL] 1741) and international standards (i.e., International Electrotechnical Committee [IEC]) for DER interconnection, testing, applications, safety, and control/monitoring. The Program develops advanced modular plug-and-play interconnection and control technologies for integrating DER with electric power systems and local loads for seamless operation.

Distributed Sensing, Intelligence, & Control Technologies

The Program develops distributed intelligent agents to diagnose local faults and coordinate with power electronics and other existing, conventional protection schemes to provide autonomous control and protection at the local level. This work will help users and electric power system operators achieve optimized control of a large, complex network of DER systems and will provide remote detection, protection, control, and contingency measures for distribution systems. In addition, new power distribution concepts (direct current grid) and advanced power electronics will be researched and developed.

Distribution System Simulation & Analysis

The Program develops simulation and analysis tools to support detailed analyses of complex interactions of DER, controls, alternative delivery concepts, and policy/institutional influences. This work will provide a virtual test bed for development of technologies and applications and establish technology targets, quantify benefits, and provide viable business models for DER and advanced distribution system implementation.

Test Beds & Field Demonstration

The Program operates the NREL DER Test Facility, which conducts demonstration of advanced interconnection hardware and validation of interconnection standards. The Program also conducts phased demonstration of DER system integration, progressing from the packaged system level to the facility, utility, and smart utility levels. This work will provide real performance data on the grid penetration effects of DER, demonstrating an acceptable level of risks to help gain widespread acceptance of DER aggregation. Advanced distribution concepts are also being demonstrated.

Stakeholder & Institutional Adoption

The Program promotes state and federal adoption of uniform interconnection standards; supports state regulatory reform to remove DER rate, tariff, and other regulatory barriers; collaboratively develops innovative regulatory approaches to integrate DER within state and regional systems; and supports development of streamlined state/local siting and permitting. This work helps gain stakeholder acceptance and remove constraints and barriers that impede the modernization of our current electric distribution infrastructure.

Success Stories

Connecticut Demand Response Deployment Project

The Electric Distribution Transformation Program is partnering with Connecticut's Energy Office and Department of Public Utility Control, Northeast Utilities, and Nxegen, Inc., to demonstrate the use of innovative "demand response" technologies in southwest Connecticut to improve electric reliability, reduce consumer prices and market volatility, reduce power plant emissions, save money, and improve domestic security.

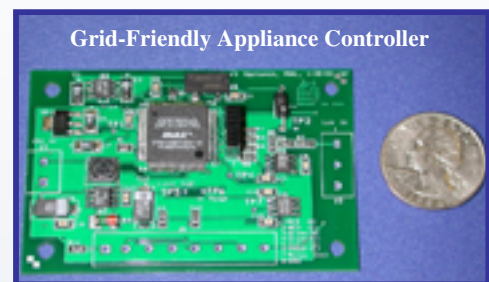
Under the project, up to 1,000 customers (representing 25 to 50 MW of managed load) will have the ability to curtail their real-time electricity purchases in response to market prices and during periods of highly volatile wholesale prices. Curtailing 50 MW of load during times of relatively high energy prices would provide substantial savings for the 1,000 customers and significantly reduce congestion for the remainder of the regional market. The project is expected to relieve an electricity crisis in southwest Connecticut, a load pocket identified as one of the top reliability risks on the nation's electric grid.

The Connecticut project will provide a national model for other regions and help reach a Program goal of peak load reduction through broad implementation of improved demand management practices. The project has the following stages:

- Install Nxegen's devices—an innovative, two-way, real-time wireless electricity data and communications system and end use control technology—for up to 1,000 commercial, retail, municipal, and industrial electricity customers in southwest Connecticut.
- Operate demand response and load conservation activities with the target customers.
- Manage system peak demand to reduce wholesale electric commodity prices through demand-side participation in the wholesale markets.
- Measure and validate the energy, economic, and environmental benefits of the demand response demonstration.
- Develop a detailed model that quantifies the impact of demand resources in the wholesale electric commodity and transmission resource planning markets.

National Interconnection Standard 1547

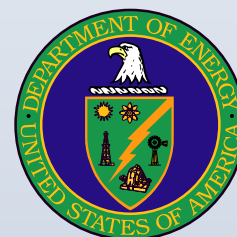
The Electric Distribution Transformation Program is leading the efforts within IEEE to develop standards for the interconnection of DER with the electric power system. In June 2003, IEEE 1547, Standard for Interconnecting Distributed Resources with Electric Power Systems, was approved by the IEEE Standards Board. This standard establishes the long-awaited technical foundation to allow interconnection of all distributed generation technologies to the electric grid. Approval of this standard will have a significant impact on how the energy industry does business and will influence how the electrical distribution system will operate with distributed generators and two-way flow of electricity. This national standard has the potential of being used in federal legislation and rulemaking, in state public utility commission (PUC) deliberations, and by more than 3,000 utilities in formulating technical requirements for interconnection agreements for distributed generators with the electric grid.



Pacific Northwest National Laboratory's Grid-Friendly Appliance Controller.



A U.S. power plant.



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